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LAWS OF TRADE — RAILROAD FARES.

Our readers will perceive that the last number contains the fifth and concluding essay on this subject, by our esteemed friend and correspondent, *Charles Ellet, Jr.*, C. E. We have more than once offered our testimony to the service Mr. Ellet has rendered the profession and the public generally, in reducing the investigation of this all important topic, to strict mathematical language, thereby placing his demonstration, beyond the reach of doubt.

Since we last noticed this subject we have had additional opportunities of ascertaining the necessity of correct principles for the establishment of railroad tariffs, and the lamentable effects resulting from a want of such principles. We were not aware that so much ignorance actually existed on the part of those most concerned—the stockholders and directors of railroads. It is sufficient to say that we have heard the doctrine boldly announced that the directors of a road are not bound to afford any accommodations or inducements to increase the traffic of a road, and that they have the right to run their trains often or not at all, just as may suit their own views.

Of this we have more to say hereafter; what we intend at present, is to propose to Mr. Ellet, the subject for a supplementary essay to those already published, viz., the investigation of the loss sustained by the working a road beneath its capacity—either by not running a sufficient number of trains or by running trains not filled, when a slight decrease in fare would fill them. We would further suggest the introduction of another element, the increased traffic caused by an increase in the accommodations of a road, particularly in the vicinity of large cities. It is well known that in such cases the number of persons making a permanent residence near a city, is in direct proportion to the inducements offered, and that the expression for the increase of business on such a road, must include

as an element, the increase of population at one of the termini. We are aware that this subject is incidentally mentioned in the papers of Mr. Ellet, but we propose the topic for more extended consideration in a future number.

NEW FORM OF RAIL.

We acknowledge with pleasure the receipt of a pamphlet, from *Benjamin H. Latrobe, Esq.*, C. E., containing a description of a now form of rail, to be called the Z rail.

The name of this gentleman, is at once sufficient to demand for his improvement the consideration it deserves, and to distinguish it from that class of inventions which is characterized rather by ingenuity and curiosity, than by practicability and simplicity. Our readers are aware that Mr. Latrobe has been employed to examine the various modes of construction now in use, and that from his own experience he is well qualified to propose improvements in this most important part of railroads. In a future number we hope to be able to give an outline, at least, of the peculiarities and advantages of the Z rail.

For the American Railroad Journal and Mechanics' Magazine.

ON THE TRUE THEORY OF CRANK MOTION. By *W. Mc Clelland Cushman*, Civil Engineer.

(Continued from page 7.)

Recurring now to our general equation of equilibrium

$$\int dz \cos B P' = zp'$$

let the foregoing values of B and P′ be substituted instead of them in that equation, and values expressed in terms of z and data replaced sine A and cos A ($= \sqrt{1 - \sin^2 A}$); it will then have taken an integrable form. We have, however, yet to observe of that term requiring integration by sines, that in actual cases the difference in length between l and r will never be less than 2 to 5. Accordingly performing the evolution, we get

$$\sin z . \frac{l}{2r} - \sin^3 z \frac{l^3}{16 r^3} - \sin^5 z \frac{l^5}{256 r^5} \text{ etc.}$$

in which it is therefore clear that all terms except the first may be disregarded for all purposes not entirely speculative. This amounts to taking cos A = 1, in the term in which it does not rise above the first power, which again may clearly be done without injury to the practical accuracy of the result, since from the smallness of the angle A even when the position of the crank gives it its greatest value, its cosine cannot differ materially from 1, and the difference is of course in other positions still less worthy of consideration. Observing these points, we obtain the following expressions of the *amount*

$$1^{o},\ 2^{o},\ 3^{o},\ 4^{o}\left\{\begin{array}{l} +\,\mathrm{P}.\int dz\left(\left(\sin z-\sin^2 z\,\frac{l^2}{4r^2}+\sin z\cos z\,\frac{l}{2r}\right)\cos m+\sin m\left(\cos z-\sin^2 z\cos z\,\frac{l^2}{4r^2}-\sin^2 z\,\frac{l}{2r}\right)\right)\\ -\,\mathrm{P}.\int dz\left(\left(\sin z-\sin^2 z\,\frac{l^2}{4r^2}+\sin z\cos z\,\frac{l}{2r}\right)\cos m+\sin m\left(\cos z-\sin^2 z\cos z\,\frac{l^2}{4r^2}-\sin^2 z\,\frac{l}{2r}\right)\right)\\ -\,\mathrm{P}.\int dz\left(\left(\sin z-\sin^2 z\,\frac{l^2}{4r^2}+\sin z\cos z\,\frac{l}{2r}\right)\cos m+\sin m\left(-\cos z+\sin^2 z\cos z\,\frac{l^2}{4r^2}+\sin^2 z\,\frac{l}{2r}\right)\right)\\ +\,\mathrm{P}.\int dz\left(\left(\sin z-\sin^2 z\,\frac{l^2}{4r^2}+\sin z\cos z\,\frac{l}{2r}\right)\cos m+\sin m\left(-\cos z+\sin^2 z\cos z\,\frac{l^2}{4r^2}-\sin^2 z\,\frac{l}{2r}\right)\right)\end{array}\right\}=\mathrm{M}$$

of moment communicable to the crank while running over the respective arcs, D M, MD′, etc.

It is not however absolutely requisite to operate separately upon each fraction; for as the 1° and 4° are precisely alike exeept in respect to engines which affect two terms of each, and have precisely similar limits, it will amount to the same thing to add them together, cancelling like terms, having contrary signs, before actually performing the integration; and so of the 2° and 3°.

Reducing accordingly, we get

$$\left\{\begin{array}{l} +\,2\,\mathrm{P}.\int dz\left(\left(\sin z-\sin^2 z\,\frac{l}{4r^2}+\sin z\cos z\,\frac{l}{2r}\right)\cos m-\sin m\sin^2 z\,\frac{l}{2r}\right)\\ -\,2\,\mathrm{P}.\int dz\left(\sin z-\sin^2 z\,\frac{l^2}{4r^2}+\cos z\cos z\,\frac{l}{2r}\right)\cos m.\end{array}\right\}=\mathrm{M}$$

and then integrating each between its respective limits, viz: $z=o$ and $z=$ D M or D M′ for the first and $z=$ D M or D M′ and $2=180^{o}$, for the second,

$$\left\{\begin{array}{l} +\,2\,\mathrm{P}.\left(-\cos z+\left(\frac{\sin 2z}{4}-\frac{z}{2}\right)\frac{l^2}{4r^2}+\sin^2 z\,\frac{l}{4r}-\left(\frac{\cos 2z}{4}+\frac{z^2}{2}\right)\frac{l}{8r}+1\cdot+\frac{l}{32r}\right)\\ +\,2\,\mathrm{P}\cdot\left(\cos z-\left(\frac{\sin 2z}{4}-\frac{z}{2}\right)\frac{l^2}{4r^2}-\sin^2 z^2\,\frac{l}{4r}+1-\pi\frac{l^2}{4r^2}\right)\end{array}\right\}=\mathrm{M}$$

wherefore, finally, after reduction to its simplest state, will

$$4\,\mathrm{P}-\mathrm{P}\left(\cdot\,(z^2-\sin^2 z)\cdot\frac{l}{8r}+\frac{\pi.l^2}{2r^2}\cdot\right)=\mathrm{M}.$$

such is the total amount of moment communicable to the end of the crank, in the direction of its motion, during a complete revolution. And as the actual moment of the power during a revolution, or double stroke of the pistons, is expressed by $2 \times 2\ P$ when radius $= 1$, we perceive that an amount of moment expresed by

$$P\left[(2^2 - \sin^2 z)\frac{l}{8r} + \pi \cdot \frac{l^2}{2r^2}\right]$$

must always be lost, in conveying the power for the piston to that point.

As previously shown, the actual moment compared with the moment of the power expended, determines the proportion of effect prcduced, etc., that is

$$\frac{M}{4P} = 1 - \tfrac{1}{4}\left[(z^2 - \sin^2 z)\frac{l}{8r} + \frac{\pi l^2}{2r^2}\right]$$

will always designate the proportion of the power actually effective upon the end of a crank, in the direction of its motion.

So also the actual amount of moment lost compared with the moment of the power expended, viz.

$$\frac{4P - M}{4P} = \tfrac{1}{4}\left[(z^2 - \sin^2 z)\frac{l}{8r} + \frac{\pi l^2}{2r^2}\right]$$

will always designate the proportion of the power lost, or expended entirely without effect.

Translating this result into words, we perceive then, that $\frac{1}{16}$th of the difference of the squares of the arc and sine of the arc, of the maximum into the ratio of the throw of the crank to length of connecting rod, plus half the square of the same ratio into the arc of the quadrant, will always give the true proportions of power lost in conveying it from the pistons to the end of the crank.

That the particular origin of the deficit of moment which has been shown to exist, is as was previously asserted, is now easily made apparent. For, taking the expression of that deficit, it is clear that, as the length of connecting rod is increased, the loss of moment will diminish in amount; and finally when the length is supposed to be indefinitely great, we must have

$$4P - P\left[(z^2 - \sin^2 z) \cdot 0 + \frac{\pi}{2} \cdot 0\right] = M$$

and consequently $4P = M$

showing that, in that case, the amount of moment communicated would be just equal to the moment of the power expended. Now as the supposition which has been made with reference to length of connecting rod amounts to nothing more than supposing the power to act directly upon the end of the crank *in directions constantly parallel* (*Note* 2,) we perceive that the *deficit* of moment and

corresponding loss of power is entirely attributable to the *obliquity* of *the connecting rod* with reference to the fixed direction of the power.

To make application of the formula which has been established, let l be supposed = 16 inches, and $r = 40$ inches. Then since sine A = cos z when the crank is at the position of the maximum, and sine $z \frac{1}{2} l$ = sine A r universally, we have

$$\frac{\text{sine } z}{\cos z} = \frac{2r}{2} = \text{ton } z = \frac{80}{16} = 5.$$

for the tangent of the angle of the maximum, which accordingly proves to be 78° 41½′; also

$$z = \frac{78° \cdot\cdot 41\frac{1}{2}'}{180°} \times 3 \cdot 1416 = 1 \cdot 3734; \text{ and } \frac{l}{r} = \frac{16}{40} = \cdot 4$$

Hence $$\frac{4\,P - M}{4\,P} = \frac{1}{4}(\cdot 0464 + \cdot 1256) = \cdot 043 \qquad (1.)$$

Showing that in engines of such dimensions very nearly 4⅓ per cent of their powers is expended without effect upon the crank.

I have previously established, experimentally, the total loss from the crank in practice, for engines of precisely these dimensions, at ·0583 P. So that about ¾ of the total loss of power, *is entirely independant of friction of parts;* and is ascribable, exclusively, to the influence of the first of the two general causes of loss of effect named in setting out.

With regard to the resistance of friction opposing the motion at rubbing points, the second of the two general causes of the reduction of effect in crank motions:—the whole quantity of power abstracted by friction is made up of the following distinct items, viz.

1°. Friction in the guides of the head of the piston rod, caused by the reaction of the force communicated to the connecting rod upon those guides.

2°. Friction at the points of the connecting rod.

3°. That taking place within the cylinder, and made up of the attrition of the piston in the cylinder, and of the slide valves, which regulate the circulation of steam.

As to the amount of force abstracted by the reaction of the power in the guides:—Let $\frac{1}{m}$ represent the ratio of friction to pressure between lubricated sufaces of iron: then as the degree of direct pressure, at right angles to the guides, at any point of the stroke is expressed by P′ sine A we must have $\frac{P' \text{ sine A}}{m}$ for the corresponding proportion of friction; or replacing P′ by its value P cos A, and putting a for the mean resistance we must have for the total moment of resistance

$$\int d\left(\tfrac{1}{2} l \cdot \overline{1-\cos z}\right) \cdot \frac{\mathrm{P} \sin \mathrm{A} \cos \mathrm{A}}{m}$$

and consequently,

$$\int d\left(\tfrac{1}{2} l \cdot \overline{1 \cos z}\right) \frac{\mathrm{P} \sin \mathrm{A} \cos \mathrm{A}}{m} = \tfrac{1}{2} l (1 - \cos z)\, a$$

writing now cos A = 1, for the same reason as before; and limiting the integration between $z = o$ and $z = 90^{\circ}$, because A is a maximum at the middle of the stroke and our equation would in consequence give equal results upon either side; we obtain, on taking the integral

$$a = \frac{\mathrm{P}}{m} \cdot \frac{l2}{8 r^2}$$

cos, as the value of m for such surfaces in machinery, is settled experimentally at 24, we may write, in general, for the mean resistance from friction caused by the reaction of the power in the guides of the piston head

$$a = \frac{\mathrm{P}\, l2}{192\, r2}$$

Hence when $l = 16$ and $r = 40$ we have

$$a = \frac{.16}{192} \mathrm{P} = \cdot 0008\, \mathrm{P} \qquad (2)$$

2. With reference to the friction at the points of the connecting rod:—Its direct influence at those points being necessarily diminished in the ratio of the radii of those points to the length of the connecting rod, we should have, putting d for the mean diameter of the points.

$$a' = \frac{\mathrm{P}\, d}{m\, r} = \frac{\mathrm{P}\, d}{24\, r}$$

for the general value of this item; accordingly when $d = 3$ in. and 2 and r as before, we have $a' = \cdot 0030\, \mathrm{P}$ (3)

3. The slide valves (shown at $x\,x$ in the figure) worked alternately to and from by the eccentric, keep up at all times communication with the boiler and one side of the piston, and with the atmosphere and the other side; and being kept to their seat by the pressure of steam, must subtract from the power a quantity proportionate to their area, in virtue of friction between the surfaces sliding in contact.

If then v = area of the slides; δ = diameter of the pistons; s = range of the slide; u the pressure of steam per unit of surface; and $\frac{1}{m'}$ = the proportion of friction to pressure of the surfaces in contact; then as the slides accompany the motion of the piston, we shall have $\frac{u\,v}{m}\, s$ for the moment of the resistance of the slides, and

$u\,\delta^2\,\frac{\pi}{2}\cdot l$ for the moment of the pressure of steam upon the pistons, each during equal intervals, to wit, the stroke of the piston. The ratio of these two quantities will accordingly give the proportion of resistance to power expended. We have accordingly

$$a''=\frac{\frac{u\,v}{m'}\cdot s}{u\,\delta^2\,\frac{\pi}{2}\cdot l}=\frac{2\,v\,s}{m'\,\delta^2\,\pi\,l}$$

for the general value of the resistance from friction of the slide valves. And the friction of ground and polished surfaces of iron being $\frac{1}{16}$ the pressure when $v=39$ in. effective surface, $\delta^2=125$, and $s=3$ inches, as in the case of the engines which furnished the value of the total loss, we have consequently

$$a''=\frac{2\times 39\times 3}{10\times 196\times 16}=\cdot 0072 \qquad (4)$$

As to the remaining item, the resistance to the motion of the piston from friction at the periphery of contact of its disc against the interior of the cylinder, it is necessarily a constant quantity from the construction of the discs; and bearing consequently no relation to the pressure of steam, it is impracticable to express it *generally*, in terms of P. But the working pressure and the absolute amount of resistance, being in the case of these engines known, its amount in the particular instance of such engines, may be easily established. For the total resistance of an engine without any load, minus the friction of its wheels, will be nearly the value of the absolute resistance from friction of the piston; because the slide valves being kept to their seats by the pressure of steam upon them, cannot present any sensible resistance in such case; and the friction of the pivots, etc., when unloaded, is also inconsiderable.

Now the resistance of those engines unloaded exclusive of that of their wheels amount on the average to about 50 lbs., and their working pressure of steam, is about 60 lbs. per square inch, (effective.) We have consequently

$$50 : 60\times 196 :: a'''=\frac{50}{60\times 196}=\cdot 0041 \qquad (5)$$

for the proportion of power abstracted on account of resistance from friction at the periphery of contact of the pistons of the engines in question.

Such, consequently, are the results of accurate estimation, a priori, of the respective items of power lost in virtue of each of the two general causes which always limit the effect producible upon the crank by a given expenditure of power: and these results when

aggregated, ought to agree with the total loss obtained directly, from experiment upon the engines themselves.

Recapitulating accordingly all foregoing results for this purpose, we obtain from

Equa.	(1,)	the loss [direct] from deficit of momentum, etc.,		·0430
"	(2,)	"	[indirect] from friction caused by reaction in the guides, etc.,	·0008
"	(3,)	"	" at points of connecting rod,	·0030
"	(4,)	"	" of slide valves,	·0072
"	(5,)	"	" of the discs of the pistons,	·0041
		Total amount of power lost,		·0581 P

Showing that in locomotive engines of the foregoing dimensions, we ought, from *due estimation* of the influence of the two causes inseparable from the action of the crank, to *expect*, on actual trial, to encounter a loss of power of ·0581 P.

The total amount of loss, *by experiment*, in the case of engines of precisely these dimensions, as stated in the note previously referred to is accurately

$$\frac{1}{8}\times\frac{15-8}{15}=\cdot0583\ \mathrm{P};$$

or rather of P reduced to the fulcrum of the motion at the bearing of the impelling wheels upon the rails, which amounts to the same thing; because the wheel and crank being connected together in an invariable manner, no further change can take place in conveying the effect from the end of the crank to the bearing upon the rails, than mere reduction of pressure in proportion to velocity of parts; in which case, as previously shown, the effects produced at each point are perfectly identical and convertible the one with the other.

The harmony of the results we have deduced from principle, with fact as developed by experience, is then most remarkably complete; (*Note* 3,) and nothing more is needed to verify the principle of the formulæ which have been investigated, and establish them as being the proper constituent elements of the true theory of the crank.

Albany Dec., 1840.

Note 2. This is the case of *minimum loss*. However, from the nature of things, the connecting rod must always, in actual cases, be of very limited length; and rotation of the crank cannot consequently proceed without the aforementioned *obliquity* of the connecting rod, etc. So that practically speaking, the case of the minimum, in which the loss *would be* zero, is unattainable. It does admit, nevertheless, of a highly important *partial* application to practice which I may hereafter take occsion to elucidate.

Note 3. The actual deviation of one of these results from the other is ·0002 P, or 1 part in 5000; *which is less than a half pound Avoirdupoise upon the full propelling power of a locomotive engine;* it would be difficult to point to any department of scientific investigation where laws and principles are so minutely borne out by experience.

For the American Railroad Journal and Mechanics' Magazine.

EXAMINATION OF THE REPORT OF THE CANAL BOARD OF NEW YORK, RESPECTING THE ENLARGEMENT OF THE ERIE CANAL, ETC., MADE APRIL 11, 1840.

by E. F. Solomons

The report of the canal board which we propose to examine, discusses at length the project of the Erie canal enlargement, advocates strongly its prosecution, and that of the canal system generally, and endeavors to prove that the resources of the State are adequate for the purpose.

It is consequently devoted, a very considerable portion of it, to an examination of the probable revenue from the canals for the next seven years based upon the rate of increase for years past. Its authors, although influenced by "a rigid determination to be governed only by facts," have, as we think, by the singular manner in which the subject has been treated, arrived at conclusions which are untenable, not warranted by the premises, and from their character, calculated to mislead, and produce great mischief and injustice.

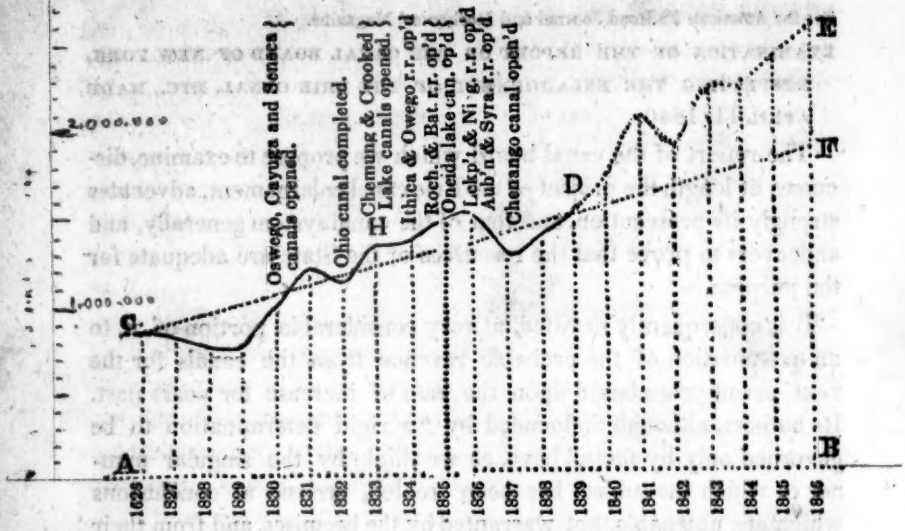
The Erie and Champlain canals, being the *only* canals from which the State has derived a *nett* revenue, were opened for navigation in 1825.

The tolls received annually from these works, after deducting the expenses of collection, are stated in the report as follows:

1826	$839,925,02	1835	$1,395,306,26
1827	849,032,07	1836	1,504,384,05
1828	786,236,64	1837	1,233,648,84
1829	763,527,91	1838	1,365,506,80
1830	990,842,96	1839	1,537,532,92
1831	1,187,139,00*		
1832	1,059,006,36		$16,134,920,30
1833	1,317,258,33	Deduct for 1831	486,350,73
1834	1,305,573,14		
		Total,	$15,648,569,57

For the purpose of exhibiting at one view the annual revenue as above, we have constructed the following diagram in which the line A B is divided into equal parts, corresponding to the different years from 1826 to 1846.

* $486,350,73 added on account of change in fiscal year. See p. 3 of report.



The vertical lines as A C, etc. drawn from these points have their length in proportion to the revenue for each year respectively, and hence the curved line C H D represents the changes or fluctuations of the revenue from 1826 to 1839. The continuation of this line from D to E exhibits the estimated revenue for the next succeeding seven years agreeably to the report.

For the fourteen years ending at D, the whole amount received as above is $15,648,569,57. Making this the sum of an arithmetical series with 14 terms, of which the revenue for 1826 is the first term, the average annual increase is found to be $42,743,07. This gradual increase is represented by the right line C F from which it appears that the revenue for 1839 exceeds the *average* for that year, and of the years intermediate to 1826, *seven* are below the average, and *five* only above. Comparing this average increase continued to 1846 with the estimated revenue as given in the report, and the result is as follows:

Year.	Revenue as estimated in the report.	Revenue on the supposition of a gradual increase.
1840	$1,733,975	$1,438,327,99
1841	2,077,493	1,481,070,05
1842	1,853,261	1,523,814,13
1843	2,305,201	1,566,557,20
1844	2,284,752	1,609,300,27
1845	2,441,786	1,652,043,34
1846	2,632,672	1,694,786,41
Total,	$15,329,140	$10,965,899,39
	10,965,900	
Difference,	$4,363,240	

The total amount received on the supposition of a *gradual* increase at the end of the seven years is *less* than the estimate of the report by $4,363,240,00.

The opinion is expressed in the report, p. 5, that "very great changes in the permanent sources of our trade cannot be well anticipated within seven years." In this we fully concur, and hence are the more surprised at being told, p. 14, that this "Board find *every reason* for believing that the estimate for the next seven years, which they have given, will be *more than realized.* Indeed, it is their *firm belief* that these estimates are *underrated*, and that the *arithmetical* ratio of increase which they have presented is *too narrow*," etc., etc.

It is, we think, quite obvious from an inspection of the diagram, that the revenue for the next seven years cannot be represented by the curved line D E *unless* "very great changes in the permanent sources of trade," occur within that period.

Although the probability of this is denied in the report, yet very considerable changes seem to be anticipated, viz. in the opening of the Wabash canal, and Blossburgh railroad, the latter of which is to furnish coal for transportation on the canals.

So long as the price of wood at the salt works in Onondaga does not exceed $2,20 to $2,80 per cord, it is not easy to perceive how coal from Blossburg can be used with profit in the manufacture of salt. The coal mines of Blossburgh are as far from Syracuse as those of Carbondale from New York city, and it is not probable that coal in the limited quantities in which it will be at first used, can be afforded at Syracuse for less than $4,50 to $5,00 per ton. Similar remarks will apply to its use for other purposes than that of the manufacture of salt, and hence there is no very great prospect of its being used to that extent on the line of the New York canals for the ensuing seven years, as to make any great difference in the revenue of the canal in that period. There is most certainly no well founded reason for supposing, in the language of the report, p. 11, that the Blossburgh coal "may be brought even to tide water, and compete *successfully* with the foreign article."

The Wabash canal, with its branches extending into Ohio and Indiana, will, when completed, add somewhat to the business and revenue of the Erie canal, but it must not be forgotten that the *gradual* increase in tolls which *we* have assumed *is derived from the ratio of past years*, during which time, the population of the country immediately dependent upon the canals has been increasing in a more rapid ratio than it will probably do for the next seven years

and the *permanent* sources of business have also greatly increased by the construction of important lateral and tributary works, among which may be enumerated, the Oswego, Cayuga and Seneca, Chemung, Crooked Lake, Chenango, and Oneida Lake canals, the Ohio State canal, the Ithaca and Owego, Rochester and Batavia, and Lockport and Niagara Falls railroads, etc., each of which has contributed materially to the tonnage and revenue of the Erie canal. As to the increase in the revenue from the transportation of salt to supply the States and Territories west, no accession from this source greater than has heretofore been experienced can reasonably be anticipated. That the traffic in this article will continue to increase we do not doubt, but not probably in a greater ratio than hitherto. The brine springs of the Kenhawa and Muskingum and also of the Kiskiminitas are now, as we are informed, furnishing brine of much greater strength than formerly, being drawn from a lower salt formation. Those upon the Grand river in Michigan promise to be very productive. These circumstances combined with the very low price of fuel in those sections of the country, may eventually exclude in a great measure the salt of New York from the western market.

The writers of the report seem not to have been impressed with the fact that during the period of the extraordinary advance in prices, through which the country has just passed, a practical *reduction* was at the same time taking place in the tolls, the effect of which was to draw to the canal a greater than ordinary amount of business, and that this stimulus may lose gradually its effect as prices again recede. The canal tolls have no reference to the value, for the time being, of the articles transported, but are regulated solely by the quantity. The toll of a barrel of flour for any given distance is the same, whatever may be its market price. Hence when flour sells at $10, it pays only *one half* the *relative* amount of toll that it does when worth only $5,00, and so of every other commodity. The reduction in prices which is now taking place, consequent upon a return to a sounder condition of the currency, will produce the same practical effect upon the business of the canal that an increase in the tolls would, under a different state of things, that is, it will tend rather to prevent a rapid increase in the business and consequently of the revenue of the canals.

Although we have examined the report with much care, we have discovered no allusion to the circumstance of the two lines of railway, which are constructing from the Hudson to lake Erie, one of which is now completed for two thirds of the distance, and upon

which a large amount of freight is destined to be carried, which if it does not diminish the revenue of the canal will prevent its being as great as it otherwise would be. It is true, that at present, most of the railway companies along the line of the canal are compelled to pay tribute to the State for the privilege of carrying freight. This most impolitic and unjust state of things cannot long continue. The line of railway, from its being available at all seasons, and from the rapidity of the transit upon it, will carry merchandize to a very considerable extent, even at higher rates than are charged upon the canal.

Flour and wheat and other products of the country will also find its way to market to some extent upon the railway. What effect this will have upon the revenue of the canal when the disgraceful plan of levying "black mail," to which we have alluded, is discontinued by the State, can be easily anticipated. By recurring to the table p. 50, appended to the report, it will be perceived that the amount of tolls received on merchandize on the Erie canal in 1839 was $524,387,00. For flour and wheat $363,180,00, both together amounting to two thirds of the whole revenue of the canal. Of these two articles it will be safe to say, that a portion of the flour and wheat, and a large portion of the merchandize, will be conveyed upon the railway, which, with some other lighter and valuable articles will abstract from the tolls of the canal, an amount probably equal to $300,000, or not less than between one-fifth and one-fourth of the whole revenue of the canal.

Much importance appears, in the report, to be attached to the facilities to be afforded by the enlarged canal, in contributing to an increase in the revenue, thus losing sight of the fact, that in all probability, the enlargement, if prosecuted with all available means, cannot be completed within the seven years, and instead therefore of aiding, will serve rather to embarrass the navigation for the whole of that period.

Indeed, we find it stated in the report p. 34, that the work east of Montezuma may be "completed within the next *five* years," and that west of Montezuma "within *two* or *three* years" after completing the enlargement east of that point.

There is not, in any view which can be taken of the subject, any good reason for supposing that the calculations as it respects the prospective revenue of the canals as given in the report, will be realized.

We cannot forbear calling attention particularly to the fact that the words of the report, do not agree with its figures. It is stated,

p. 23, "that the certainty of an increase founded upon a *strict arithmetical proportion* at least corresponding with that which has *uniformly prevailed since the completion of the canals* has been shown to the satisfaction of every reasonable inquirer."

To the correctness of this remark we are ready to respond, but the *calculations* in the report are not in harmony with it. The proportion or ratio of increase, assumed in the report, is not an *arithmetical* one, and varies very materially from that which has "*uniformly* prevailed since the completion of the canal," giving, as we have already shown by the diagram, an aggregate amount of tolls at the end of the seven years annexed in the estimate greater by over *four millions*, than it would be computed in a "*strictly arithmetical proportion.*"

The probable annual expenditure for superintendence and repairs of the canals is estimated in the report at $500,000, and as a reason for the sufficiency of this estimate it is stated, p. 16, that "the improved construction of the enlarged canal will render it less liable to injury, etc," evidently forgeting, that during the whole seven years for which the estimate is made, the enlargement will still be going on, and that the expense for repairs consequent, upon the preservation, of an uninterrupted navigation in the old channel, while the work is being executed will probably be *greater* than it would be under any other circumstances.

The present Erie canal was constructed with stone locks and culverts and with aqueducts, either of stone or supported upon stone piers and abutments. The expense for repairs have been caused *mainly* by ruptures or breaches in the banks and by removal of deposits from the bed of the canal and repairs of the towing paths, rather than by any defects or weakness in the mechanical work. The pressure and volume of water being trebled upon the enlarged canal, casualties of the description first named, will be more likely to occur, producing much greater damage in proportion, and the expenditures for the other items, will also undoubtedly be increased by the enlargement. The "total annual charge on the revenues" is estimated in the report at $1,131,250, p. 15. This sum assumes the "annual average charge for superintendence and repairs" of *all* the *State* canals at $500,000.

Although we believe this to be much less than would be estimated by "a timid capitalist inquiring into the profit and security of a proposed investment," yet we will take the estimate of the board as above, viz: $1,131,250, which for seven years is $7,918,750

The estimated receipts from tolls for seven years, as above, amounts to	10,965,900
	3,047,150
Deduct the principal of the debt redeemable in 1845 and 1846,	2,933,839
Leaving a surplus of only	$113,311
According to the estimate in the report this surplus is	4,476,551 !!

Illusory as the estimate of the report evidently is, yet it is made the basis on which is predicated the ability of the State, p. 23, to pay the interest on an increase of the State debt "of 15 millions at 6 per cent. or 21 millions at 5 per cent. incurred during the next seven years, and *yet to leave large surpluses*"!! It is moreover stated that "in addition to all this, causes have been pointed out which *must* produce an augmentation of our canal revenues much beyond the *arithmetical* proportion of former years," or in other words that the anticipated surplus will *positively exceed* the amount above stated of $4,476,551. To this most strange conclusion the board have satisfactorily to themselves arrived by "rigidly confining themselves to a *cold* and *severe* analysis of figures and *to the application of facts that no one can controvert*"!!!

Since the presentation of the report, the legislature have authorized loans to the amount of about $4,000,000 00 [illegible]ch sum $2,500,000 is appropriated to the enlargement. These loans are not payable, it is true, within the next seven years; the interest, however must be met, which at 5½ per cent. is $220,000 00 per annum, or for seven years equal to $1,540,000 00

To pay this there remains only the surplus above	113,311 00
Leaving a balance unprovided for, of	$1,426,689 00

Assuming therefore that no more appropriations are made and debts contracted for the next seven years, and that our estimate of the probable revenue is correct, the tolls remaining unchanged, the State will be compelled, in order to meet *existing* obligations to raise by tax, the sum of $1,427,589 00.

It will not do however, to assume that no more debts will be contracted—the enlargement of the Erie canal is to cost some twenty millions more than has already been expended. The report says, p. 34, that "the completion of the work to Montezuma will cost $10,693,903 00," and that the division west "will require $7,203,040 00 in addition to the work now under contract," the latter "amounting to $1,908,253 00," making in all, for the enlargement alone, full twenty millions. The Genessee valley and Black River canals, will require at least five millions more. The Chemung canal, and enlargement of the Oswego and Cayuga, and Seneca canals

will need some four millions, making, in order to carry out the canal system on the plan already commenced, *without regard to the aid to be afforded to railroads*, full thirty millions in all. The most of this large sum will be needed within the seven years embraced in the estimate of the board, the interest accruing on which, prior to the expiration of the seven years, must be added to the amount to be raised by tax as above stated, or otherwise, *new loans must be made to pay interest.* In the above calculation the interest on loans to railroad companies which the State may be compelled to pay is omitted, as also the interest on debts contracted for the construction of such railroads as may be undertaken by the State within the seven years included in the estimate of the board.

Is it not plain that the board have overlooked in their estimate, considerations of the greatest importance? That if even their own extravagant estimates of revenue should by possibility be realized, it would be wholly inadequate to meet the liabilities of the State in the payment of interest alone, the principal of the debts contracted remaining meanwhile, untouched and undiminished?

The evidence that the enlargement of the Erie canal and the construction of the other canals in progress, cannot be prosecuted in the manner recommended by the board, and the necessary aid be given to [redacted] works, without resort to new loans, or to taxation to raise large sums to pay interest before the expiration of seven years, is so overwhelming, that we cannot imagine how any sober reflecting mind can fail to perceive, or will hesitate to acknowledge its entire conviction of the truth of our remarks.

While the funds of the State are being lavished without measure upon the enlargement of the Erie canal, is it reasonable to suppose, or safe to conclude, that other sections of the State hitherto much less favored, will quietly submit to a sacrifice of their own dearest interests? Will they not rather by a united and firm stand, demand, and *successfully*, that those works in which *they* have an immediate interest and which have the strong claims of utility, necessity and justice to recommend them, should participate in some degree in the bounty of the State?

That such a result is not only probable but *inevitable*, will not, we think be denied. Whatever may be the debt of the State, its faith once plighted, must be redeemed. The fair fame of the Empire State must not be tarnished by any act derogatory to its integrity and honor.

Whenever the period shall arrive in which the resources of the State shall be found inadequate to meet its engagements, what, we will ask, will probably be the answer of the north, the east and the

south, to the question which will then be raissd as to the mode of providing for liquidating the debt? Will they not say to the west, and to the canal counties in particular, that since it has been mainly for your benefit that this great debt has been contracted, instead of submitting to taxation we will insist that the tolls be raised upon the canal? In such a state of things it is not difficult to predict, that the west, being most dependent upon the canal will be the greatest sufferers. In their efforts, therefore, to monopolize the revenues of the State, let them beware lest they heap coals of fire upon their own heads to be atoned for hereafter by years of penance.

We would here discontinue our remarks upon the report, but there are some statements so much at variance with the views entertained by us, and withal so inconsistent, that we cannot forbear bestowing upon them a passing notice.

It is well known that very much of the tonnage of the Erie canal is furnished by the lateral, or branch canals, and that in return much passes from the former to the latter. The great expense and delay of trans-shipment between the boats of the different canals, is not noticed in the report; on the contrary, we have the following, p. 42.

"For all commercial purposes the diminution of the cost of transportation on a canal, one half, is equivalent to a reduction of its length one half. In that sense the enlargement of the channel from Albany to Montezuma (at which point, the coal of Pennsylvania sent through the Chemung canal, will be received on the Erie canal,) will operate to reduce the present distance of 206 miles, between these two points to 103 miles; and in the like sense the completion of the enlargement, from Albany to Buffalo, will abridge its total length from 364 to 182 miles; and thus *bring lake Erie with all its growing commerce within half of its present distance from the tide waters of the Hudson*" ! !

From this we understand that the Boats on the enlarged Erie canal are to be moved with double the speed at half the present cost, or, that *time* is of no consequence in commercial operations ! ! We are to understand, also, that notwithstanding the loss and extra expense of trans-shiping coal at Montezuma there is to be a gain for all commercial purposes, in the transportation of this article to market equal to a saving of *half* the distance from Montezuma to the Hudson ! !

Among the reasons originally assigned, in favor of the enlargement of the Erie canal, it was stated that it would reduce the cost of transportation 50 per cent. The Board, p. 47, have endorsed and reiterated this statement.

It was undoubtedly upon the truth of this that their conclusions as above quoted, relative to the effect of the enlargement in reducing the distance one half, was made.

Let us see how well the opinions thus advanced, will stand the test of an examination.

The expense of transportation upon the canal is made up of three distinct items.

1st, The tolls, which average upon heavy freights per ton per mile, nearly - - - - - - - - - 1 cent
2d, *Cost* of transportation average as above, about - - 1 cent
3d, The profits to the forwarders, not less than - - $\frac{1}{3}$ cent

Total per ton per mile, - - - - - $2\frac{1}{3}$ cents

By recurring to the reports from whence the Board derive their views, it will be seen that the anticipated saving of 50 per cent. applies exclusively to the second of the above items, making the anticipated *saving* per ton per mile for heavy goods on the average about 5 mills or *less than one-fourth* of the whole cost of transportation instead of *one half* as the Board have assumed.

The declaration, therefore, which we have quoted from the report, relative to the reduction in distance is very wide of the truth, and will be still further removed, when it is understood that the saving upon the second item as above, instead of being 50 per cent. will probably not exceed 25 or 30 per cent. at the utmost.

It is worthy of remark, that the canal Board do not enter into the investigation of the subject of the necessity of the enlargement to accommodate the increasing business upon it. The project appears to them to be meritorious principally from its effect in cheapening transportation, but they do not tell us, that the anticipated saving in the cost of transportation consists mainly in the saving in tractile power, which depends upon the ratio of the dimensions of the boat to that of the canal, and which *may be attained to nearly as great a degree of perfection on a small canal as on a large one*, and could have been attained without all this immense expenditure. They do not tell us either, that with half the cost of the enlargement to Buffalo, a navigation might have been opened with lake Erie, via lake Ontario, presenting only half the extent of canal navigation and which would have been the cheapest and most expeditious of all possible navigable routes for the transmission of the western trade.

Before concluding this communication we must advert to a passage in the report, p. 28, where it is stated, that "A more ample supply of water on the western division from lake Erie to the Sen-

eca river, a distance of 149 miles, *is to be secured*, by giving to the level between Lockport and Rochester an increase both of width and declivity, and the channel through the mountain ridge at Lockport, now but 30 feet wide is to be increased to 62 feet with vertical sides." The enlargement of the channel at Lockport is to be extended as we understand, to 90 feet width of surface and 9 feet in depth; being 20 ft. wider and 2 ft. deeper than the average dimensions of the enlarged canal. From Lockport the dimensions will diminish gradually towards Rochester to the size of 70 by 7. East of Rochester it is proposed to construct a large reservoir, to be supplied from the flood waters of the Genessee river. What addition those alterations together with the extra cutting through the mountain ridge at Lockport, will make to the total cost of the enlargement, we leave our readers to judge. It is to be regretted that the reports upon the subject by the Engineer department were not forthcoming at the last session of the legislature. That the expense will be very great, there can be no doubt, and it is incurred for what? "To render it unnecessary, (to use the language of the report) longer to divert the waters of the Genessee river from the mills at Rochester, which has occasioned great injury to the manufacturing interests of that city, and a consequent loss of revenue to the canal"!! And this is the reason why the people of the State are to be taxed some hundreds of thousands of dollars more, to perfect the extravagant project of the enlargement of the Erie canal—viz. that the wheat of the west may be floured at Rochester in preference to being ground at the Little Falls or the Cohoes or at any other of the numerous points where water power is to be found on or near the line of the Erie canal!

From Rochester to Buffalo including the aqueduct across the Genessee river, the enlargement is to cost by the estimate, $6,000,000. The present canal cost $2,000,000, making $8,000,000. Why it may be asked should this small remote portion of the State be thus partaking so largely of the bounty of the legislature, while other important sections are languishing through neglect, and their great and favorite projects, either wholly discarded, or put off with a miserable pittance, in the shape of a loan of the credit of the State, but barely sufficient to prevent them from being abandoned altogether?

It is a matter of deep regret, that the resources of the great State of New York are so injudiciously applied—that its great wealth and strength are, if not wholly wasted, perverted to selfish purposes, and bestowed with little regard to the necessity of the expenditure, or with apparently little consideration as to

whether they are expended in a manner to accomplish the greatest possible good.

We are fully convinced that this state of things cannot long continue. The signs of the times, are ominous of an approaching crisis, when the internal improvement system of the State, will be thoroughly anylized, and when, as we trust, such a reform wlll be effected, as will place it beyond the reach of perversion to political or merely selfish purposes.

F.

(Communicated.)

PHILADELPHIA AND POTTSVILLE RAILROAD.

We take pleasure in presenting to our readers the following extract from a notice of this work in a late number of the Pottsville Journal, and are truly glad to learn from other sources the expectation held out of this road being able to aid in delivering coal at tide water in the summer of 1841 will be realized. The coal consumers are paying pretty severely in this season for their fuel, and there is every prospect of a high price in the coming season, unless this additional avenue can be made to aid in the supply.

"This important link in our internal improvements, that is to connect this place (Pottsville) with the emporium of the State, has been rapidly progressing, and will probably be completed and opened sometime in the month of July next.

The bridges and other works have been put up in the most substantial manner, and great attention has been paid to durability and strength. The opening of the road will be the commencement of a new era in the coal business. The long mooted question will then be decided as to which mode of transportation will offer the greatest facilities and most advantageous to the coal operators. One thing is certain, that the railroad company will afford every facility in their power to induce our operators to transport their coal by the railroad in preference to the canal, delivered on the Delaware, where the company have already prepared commodious and extensive wharves for the reception of coal and accommodation of vessels waiting to load.

When we consider the vast amount of coal, merchandize, travelling and produce that will pass over this road, and the durable manner in which it has been constructed, we cannot but think that it will be a source of immense advantage to our region, and of a handsome profit to the stockholders.

Much credit is due to the company for their untiring exertions to bring the road to an early completion, and so far they have been

eminently successful. They have continued the work on the road without intermission during a period of the greatest embarrassment in the monetary affairs of the country, and that has never been equalled."

To the Editors of the Railroad Journal and Mechanics' Magazine.

PHILADELPHIA, January 6, 1841.

GENTLEMEN:—I inclose to you a communication which is already published in several of our Gazettes, and which, for the sake of extending its publicity, I would be gratified to see favored by you with a place in your Journal. The facts it states are important; and although they bring to me no conviction I had not before,—to others they may afford stronger evidence than they have before had, and induce an adoption of what may be to their advantage.

PRESERVATION OF WOOD AND CORDAGE.

To divest vegetable matter of its tendency to decay and impart to it prolonged duration, is very generally desirable; and the following additional testimonials in favor of an easy and cheap method of effecting it, which has for some time been before the public, will probably form an interesting article of intelligence to a very large part of the community.

Timber and cordage, from their extensive usefulness, must become principal subjects of its application; but their seems to be no reason why canvass and all cloths and fabrics of vegetable material, when *preservation* is the objeet of attainment, may not share its benefits.

The first of the testimonials referred to, is a certificate given to the patentee by the city commissioners and city carpenter of Philadelphia, to the following effect:

PHILADELPHIA, Dec. 7th, 1840.

"Dr. Edward Earle—Sir—We have examined the condition of that portion of the wooden pavement in Chestnut street, which is between 5th and 6th streets—and that in 6th street, between Chestnut and George streets—and are enabled to make the following representation:

These pavements were laid down, at the same time, in the summer of 1839—about 18 moths ago. They are of blocks of hemlock, 6 inches square by 18 inches long, and perfectly identical as to the kind and quality of timber.

The first—those in Chestnut street—were laid without having undergone any previous treatment to preserve them, and are now so far in a state of decay as to require renewal in many places.

The second—those in sixth street—before being put down, were prepared according to your process for the preservation of timber from decay; and are at this time perfectly firm and sound. We have not been able to discover a single block of them exhibiting the slightest tendency towards decomposition.

A. D. TRAQUAIR, President.
T. K. WALLACE, City commissioner.
ENOCH THORN, City carpenter.

The above pavements were laid by authority of the committee on public highways, for the purpose of testing the effect of this process. The certificate shows the *result*.

The second tesimonial is communicated by the president of the Delaware and Hudson canal and railroad company.

"Office of the Del. and Hudson Canal Co.
New York, Dec. 30, 1840.

Dr. Edward Earle—Dear Sir—I have received a letter from James Archabald, Esq. our chief engineer, in charge of our mines and railroad, and I annex an extract from it: Very truly yours,

John Wurts, President.

Extract of a letter from James Archbald, Esq., dated Dec. 14, 1840.

"I have tested the durability (as far as time permitted) of Dr. Earle's saturated rope; and find it thus far in a perfectly sound condition; and apparently as little affected by rot as a peice put along with it saturated with corrosive sublimate; while rope of the same kind that was not prepared has became completely rotten—and I am thus far perfectly satisfied that the durability of rope will be very much increased by being prepared in the manner that this has been. We are now making experiments which will rot first, the rope saturated with the corrosive sublimate or that saturated with the sulphates. The doctor, however, must recollect that we know nothing relative to what he did with the rope to preserve it, and that before we can judge properly between the merits of his preparation and that of *Kyan*, we must know something about it."

The above has reference to several pieces of rope, (some prepared by my process, the others unprepared) sent by me to Mr. Wurts, and by him to M. Archbald to be subjected to the test of a fungus-pit. Mr. Archbald speaks with prudent reserve of the experiment, as he was not *personally* a witness of the preparation of the rope, and only presumes it, on my authority, to have been prepared with the sulphates of iron and copper. To satisfy his scruples, if really entertained, he has been instructed in a mode of ascertaining the fact, which cannot fail him.

The immediate object of the above experiment has been to ascertain the increased durability that the process by the sulphates of iron and copper is capable of imparting to the ropes used on the *inclined planes* of railroads and whether it would, for such purposes, prove equal to treatment with corrosive sublimate, which has been found effectual.

Edward Earle.

Philadelphia, Jan. 4, 1841.

For the American Railroad Journal and Mechanics' Magazine.

A writer upon arches in the New Edinburgh Encyclopedia remarks that the arch of equilibration is not what it purports to be; but the gross blunders he commits in quoting the demonstration, proves conclusively that he did not understand it; and I will undertake to convict any one who objects to it, of a total ignorance of it. Here then is a challenge to all the world. If you understand the demonstration you will be fully satisfied that it gives you the only arch for strength in any structure, and, on the other hand, if you think it is not so, I will show any one who does not understand the subject that you know nothing about it. Emmerson, Simpson, Hutton, Greggory and a writer in Rees' Encyclopedia, and others, have all examined the demonstration in question, and

pronounced it correct, though now and then to some it has proved, I admit, a stumbling block.

To Professors Strong, Gill, and Anderson, who are known to be not second to any mathematicians of the age, I am much indebted for aid in my mathematical researches; and even upon this very subject, and I can therefore speak for them in this case. They will not condemn what they have taken so much gratuitous labor to explain. Who then is it that advises the erection of circular and elliptic arches in the structure of the Croton aqueduct? Every arch that has been there put up requires about one-fourth more weight than it has upon its hances. I have petitioned the common council of our city to take the opinion of some of our eminent mathematicians upon the subject. Give us the names of those who approve of such arches and then we shall know who to meet upon the pages of our public journals. Do the engineers act wholly upon their own responsibility in this case? If so, then I presume they will not hesitate to let us know that they understand what the arch of equilibration is; and when they do so, they may expect that all objections they may have to offer to it will be properly answered.

The public should have the opportunity of looking at both sides of this question. Let it be fairly treated, and my word for it, those who object to the arch in question shall be convicted of a total ignorance of it.

Mathematicians will say that in bringing this subject up as I have done, I have performed my duty; and the common council of our city should exhonerate themselves from all responsibility in this case by putting it where it ought to be—upon our professors of mathematics; and if they, or a majority of those in this vicinity condemn the equilibrated arch they must answer in their characters, to those of all countries who now are or may be hereafter judges of the subject.

It is no answer in this case to say that the circular arch will stand. It accidentally does so in most cases, I admit, but no thanks are due upon that account to the design or the architect; for the pressure falls where no provision is made for it, and the vousoirs or arch stones are entirely useless.

In a word, if Prof. A, B, or C, shall say the circular or elliptic arch is proper in this case, let him take the responsibility and give us his name, so that the common council of our city may be justified in saying to posterity—we have done our duty—we are not presumed to be judges of this subject ourselves, and have therefore left it with those whom this community, recognises to be so; and if they have undertaken here what they do not understand, the fault is not ours.

To conclude, why should not humbug and deception be exposed in this case as well as in any other one. I say, the commissioners and engineers of the Croton aqueduct are listening in regard to the subject before us, to improper counsels; and in this movement, I am supported, as the Croton aqueduct committee of the common council well know, by some of the first characters of this city; and *we*— I say emphatically *we* shall not be satisfied with any thing short of an invitation from that common council for the mathematicians of this vicinity to give their opinion in the premises, and then we shall know whom to meet, and if this cannot be obtained from the present board we shall be very likely to apply to the next one.

OLIVER SMITH.

NEW LOCOMOTIVE ENGINE.—We are indebted to Messrs. Baldwin, Vail & Hufty, for a drawing and description of a new freight engine. The peculiarity consists in connecting the four front wheels with the large drivers. By this arrangement *all* the wheels are converted into drivers, and the whole weight of the engine is used to procure adhesion, while the advantage of the four wheels adapting themselves to the curves of the road is still retained.

It will be seen at once that this form of engine has decided advantages over the ordinary six wheel locomotive, particularly where great adhesion is required in case of heavy freight and severe grades, or short curves.

We have received a communication from our correspondent in St. Louis, in regard to gas works, etc. If possible the information desired will appear in the Journal, but we fear that we cannot comply with this request as punctually as with his last, in regard to wooden pavements.

Our readers will perceive that this, and the last number, are almost entirely made up of original matter. We have omitted our usual extracts from domestic and foreign journals, to make room for the favors of our correspondents, who will please except our best thanks, for their valuable communications.

ENGINEER'S OFFICE WESTERN AND ATLANTIC RAIAROAD, MARIETTA, OCTOBER 15, 1840.

GENTLEMEN—I have the honor to submit a report of operations on the Western and Atlantic railroad, during the 3d quarter of 1840. The accompanying documents will explain in detail, the nature and cost of the work executed.

From the quarterly return herewith submitted, it appears that the work done since the 1st of July, consists of 299,306 cubic yards of excavation and embankment, 3612 perches of masonry in bridges and culverts, 309,975

feet, board measure, of bridge timber delivered, 18 trestle piers framed, and 5 erected, 672 feet of bridging erected, besides 511 feet of superstructure of bridge framed and prepared for raising. The amount paid for which, according to contracts, is $71,597 42. In addition to this expenditure, there appears on the return, as payable on account of repairing finished sections, $4,343 88.

From the abstract of final estimates, it appears that the grading of six sections, and the masonry of two bridges, viz: Etowah and Arms, have been finished during the quarter. The amount of reserved balances paid on their completion has been $18,834.

The total amount expended up to this date, from the commencement of operations, including surveys, location, construction, repairs, the engineer service, and various contingencies, is $1,792,479 50.

The amount that will probably be required to complete the grading, masonry, and bridging of the road, according to existing contracts, is as follows:

For the 1st, 2d and 3d divisions,	$87,040 00
For the 4th division,	42,032 00
For the 5th do. not including the tunnel,	196,304 00
For the tunnel through Little Blue Ridge,	84,303 00
For contingencies on the same,	10,000 00
For the Tennessee division,	170,499 00
Making the total amount required for the above mentioned purposes,	$590,078 00

Many circumstances have contribued to restrain vigorous operations during the last quarter—among these is the terrible sickness which has pervaded the region adjoining the Tennessee line, embracing the principal part of our work in progress.

The amount expended for repairs of sections completed under the contract made prior to December, 1839, is $14,468 48.

When we take into consideration the immense height and depth of many of our embankments and cuts—the unprecedented rains of the last winter and spring falling upon green embankments built during a very dry season, we have cause to congratulate ourselves upon the small expenditure which has been necessary under this head. Moreover, we must consider this expenditure advantageous, as tending to diminish, in a great degree, the cost of keeping up the road after the superstructure shall be laid. Indeed a superstructure of Kyanized timber, laid upon banks consolidated by the settling of years, and carefully repaired by ramming into the breaches choice material, will be so firm and durable, that the cost of repairs, usually a heavy item of expense on a new road, will be quite inconsiderable.

To furnish you with details of information respecting the operations during the last quarter, I extract from the reports of the resident engineers. Mr. Stockton in charge of the 1st, 2d, and part of the 3d division, reports as follows:

"Since the date of my last quarterly report, sections No. 13 and 14 of the second division, and section No. 7 of the 3d division, have been completed and accepted; the masonry of the Etowah and Arms viaducts have also been completed and accepted, and final estimates on each rendered. The masonry of the Vinning viaduct is progressing rapidly, and gives every indication of being well and substantially executed. The foundation of the eastern abutment of the Noonday viaduct has been excavated, and in a few days the contractor for laying the masonry, will commence operations, when the work will be prosecuted with all reasonable despatch. During the past month a small culvert has been introduced on the 11th section of

the second division, in order to draw off the large quantity of surface water which collects in the vicinity of that section, after all heavy rains. The masonry and other work connected with the construction of this culvert, was done by the repairing party on that part of the railroad, and charged to repairs. The taring and sanding of the flooring of the Chattahoochee viaduct, has been seriously delayed during the past month, owing to the unfavorable weather which has prevailed. About two thirds of the flooring remains in an unfinished state, but a large force is now actively engaged in its completion. An attempt was made to complete the caulking of the above, prior to covering the same with sand and tar. This plan, however, did not succeed, the action of the sun and rain causing the seams of the floor to open to such an extent, that a recaulking of the same became necessary. A verbal contract for such amounnt of tar as may be required to complete the above, has been made, to be delivered as wanted, and on terms according with the lowest price yet paid for tar on this work.

"All of the repairing parties have been discharged from this part of the road, except two, which are now employed in the vicinity of Allatoona, and on the Franklin embankment. It has been a leading object to restore the heaviest embankments to their proper grade, and by the construction of the proper centre and traverse drains, to place them in a state to withstand the rains, etc. of the ensuing winter. A recent inspection of this part of the road, warrants me in the assertion, that with but a trifling exception on the 14th and 18th sections of the second division, the embankments are in a good state of preservation."

Mr. L. Tilton, temporarily charged with the superintendance of the 4th, and part of the 3d division, reports, that, "Upon the fifth residency a repairing force has been employed for the last month. Its operations have thus far been confined to the 20th section, where, in consequence of the banks having settled much more than could have been anticipated at the time they were made, a large amount of work was required to raise them to the necessary height. Owing to the same cause, considerable labor will be required upon several other sections; but should the weather prove favorable, and an efficient force be employed, the completion of the heaviest portion within the present and ensuing months, may be reasonably anticipated.

"The grading required upon the 25th and 26th sections of the third division, in order to raise the embankments to the requisite height, as indicated by the last spring freshet, has been contracted for by Messrs Keef and Whitesides, and that on the fourth section of the fourth division, by Hitchcock & Co. The masonry upon the latter section remains in nearly the same state as at the beginning of the quarter, the contractor having been obliged to leave the work on account of sickness. It is expected that he will resume operations in a few days, and proceed with the work as rapidly as possible. The framing of the bridge for this section, as well as that part for the 25th section of the third division, is completed, and were the masonry finished, would be raised immediately.

"Towards the completion of the piers and abutments of the Oostanauley bridge, though a return of masonry, etc. appears in the quarterly abstract, nothing has been done except the quarrying of a few perches of rock. In explanation of this return, it may be proper to observe, that a new and accurate calculation of the whole amount of work done, showed that there remained to be returned, the number of perches therein specified, as also the allowance for dressing pier ends and coping, in a manner superior to that called for by the terms of the original contract.

"Upon the masonry of the other parts of the sixth residency, nothing

has been done except upon that on the 25th section, which is progressing slowly, and will probably be completed within the present month.

"There now remains unfinished the masonry of eight bridges and arch culverts; in every case, except at the crossing of Swamp Creek on the 19th section, it is more or less advanced.

"The number of sections, the grading of which is unfinished, including three on the fifth residency upon which the grade is to be raised, is eleven; six of which, together with the masonry on the 11th, 17th, and 20th section, have been abandoned within the quater, and statements showing the amount of work done, and that remaining to be done, in each case presented. Favorable proposals for grading the 17th and 20th of the above sections, have been received, but the former has not been let, as it is understood that it has not, as yet, been formally relinquished by the original contractor."

Allan Campbell, Esq., the resident engineer of the fifth division, reports as follow:

"The work generallv has progressed very slowly most of the contractors having been, engaged with small forces. It is unnecessary again to enter into a description of the nature of the excavations on the several sections, as the full account given in my last report, is applicable to the work since done except in a few instances.

"In the deep cut approach at the western extremity of the tunnel, a material of softer nature than that met near the surface, has been found, as the depth of cutting increases, particularly at that portion immediately adjoining the tunnel. Some annoyance has been experienced by the contractor in the prosecution of these excavations, from the appearance of water, arising doubtless from springs having their origin at some higher part of the ridge; and although it percolates through the sides and bottom of the cut in scarcely perceptible streams, yet tends to render somewhat difficult of removal, a material otherwise so very favorable. In a dryer season, it is not improbable that the water here spoken, of would disappear altogether. This approach, (the westren,) is now excavated to a level with the roof of the tunnel, and it requires but little more work to prepar for the commencement of the heading.

"In the eastern approach, the material excavated continues to be only hard. It is, however, favorable for the operation of tunnelling.

"Three sections of the division, viz: the 9th, 11th, and 13th, will probably be completed within the ensuing month.

"I would urge upon your consideration; the importance of providing for the execution of the culvert masonry yet undisposed of. The prices now allowed are not sufficient to induce responsible contractors to undertake it. It is plain that one uniform price, (as at present established,) will not meet the object. What may afford a fair remuneration in one locality, may be entirely inadequate in others.

"While upon the subject of masonry, it may not be improper to remark that the above observations, as to the inadequacy of the prices which have been fixed as the standard on this part of the road, are applicable also to the bridge masonry, but with much greater weight. Abutments which are to sustain the pressure of an immense body of earth, and peirs subject to severe shocks from flood-wood in time of freshets, should be built in the most substantial and permanent manner. To effect this desirable object, sufficent inducements should be held out to responsible men, who will execute the work faithfully, and in accordance with their contracts.

"A large amount of masonry yet remains to be executed on this division. That it will be greatly to the interest of the State to increase the rates of peices fixed for this kind of work, and in proportion to the facilities for procuring stone, lime, sand &c., I am firmly convinced."

Since the date of Mr. Campbell's report, the excavation of the western approach to the tunnel through little Blue Ridge, has discovered at a distance of 200 feet from the entrance to the tunnel, a stratum of blue limestone 10 feet above the grade line lying with such a dip as will pass above the roof of the tunnel near its entrance. Present appearances in the excavation of the approach, lead us to anticipate, that the tunnel will pass almost entirely through rock. The contractor is preparing to lay a temporary track for the removal of the earth from the eastern approach, to form the adjoining embankment. Iron rail, car wheels, spikes, etc., for this purpose, with which the state is bound, by contract, to supply him, are now in course of delivery at the tunnel.

In reference to contracts for masonry, I would wish to impress you with the importance of a good execution of this branch of construction. Economy is of course to be regarded, but not so strictly as to lose sight of the advantages of permanency. The taste which governs the execution of public works in our country, is not so refined as to demand much of the ornamental in our structures. We may therefore discard, this object, and confine ourselves to consideration of durability. This end cannot be attained, without employing good material, and securing the services of good workmen. I do not hesitate to say, that the standard of prices now fixed for bridge masonry, is too low to encourage competent men to undertake and execute faithfully, contracts of this kind. In these matters, excess of liberality is less dangerous than unwise economy.

Before making a decision to adopt the Kyanizing process with the timber for our superstructure, it would be advisable to investigate the claims of Dr. Earle's system of preserving wood. The short time that has elapsed since his discovery of the process, has not afforded a fair experience concerning it. Experiments are now in progress, under the direction of the general government, for testing its efficacy, by exposing timber thus prepared, to artificial causes of decay. The cheapness of the materials used, the sulphates of iron and copper, (the common green and blue vitrol of commerce,) leads us to anticipate that it will be a cheaper mode of preserving wood, than Mr. Kyan's process, in which corrosive sublimate, a costly article, is employed. It certainly would be unwise in us not to avail ourselves of scientific discoveries, applicable to our purposes, and we are admonished by experience, of the great cost of renewals and repairs of wooden superstructures, to adopt some means of diminishing this expense. I would recommend the adoption of some process for preserving the timber seud in our bridges, as well as in the superstructure of our road.

As the time for making some decision respecting our future plans of operation approaches, it is proper to bring to your consideration the necessity of early action with regard to our superstructure. We shall require about 11,000,000 feet board measure of timber, for a single track. The facilities afforded by the neighboring country for furnishing lumber, are so extensive, and to avoid delay, preparation should be made for its delivery sometime before it may be actually needed—moreover, the Byanizing process requires the construction of suitable vats at convenient points along the line of the road. A contract for 11 or 12,000 tons of iron will require a long time for its fulfilment. In view of all these facts, an early consideration of the subject is respectfully suggested.

While on the subject of preparing materials for our superstructure, I would earnestly recommend to you that some engineer officer of our corps be detailed for a mission to England, for the actual purchase of the iron that will be required. The advantages of a thorough inspection of our rails in the course of their manufacture are obvious. Moreover, we shall

thus be enabled to avail ourselves of those improvements in details, of plans for depots, ware houses, and in the arrangements for working roads, which have been adopted in the public works of Great Britain. This plan would also saue the usual heavy charges for commissions by the purchasing agents.

Our work has recently been struggling against financial embarrassments. It needs no argument to prove that our present currency will not answer our purposes under existing laws. The bonds of the State paid to the contractors for work done are at a heavy discount. We must look to the next legislature to remove this embarrassment. The present is an important crisis in the affairs of our State. When, in 1836, Georgia awoke from her inglorious lethargy, and issued her fiat, "there shall be a railroad communication to the valley of the Mississippi," the friends of internal improvement, the friends of our country, warmly anticipated the glorious results of energetic action. Were 50,000 square miles of territory to be selected from the map of the United States, as combining the great advantages of position with the elements of prosperity, the boundaries of the selection would nearly coincide with the boundaries of Georgia. Occupying a salient angle of the continent with her fine navigable streams affording easy access to the Atlantic on one side, and the Gulf on the other—a main tributary of the mighty Mississippi almost touching her northern border—an easy passage through her territory to avoid the dangerous circuit of Florida, in connecting the maratime transit from the east with the whole coast of the gulf of Mexico—a connection with the great west incomparably easier than is afforded by the territory of any other State—rich in resources richer in prospect—why should Georgia halt or hesitate in her onward march to her proper station. We have reached the threshold of success and their should be no faltering. The alternative is presented to us of a retrogade movement to our old position of supine insignificance, or the fruition of our high hopes of the prosperity of our country.

I have the honor to be, very respectfully, Your obedient servant.

JAS. S. WILLIAMS, Chief Engineer.

Creation of Freight, by Low Rates.—[From the 6th report to the British Parliament.] Answer to Question No. 3843. I consider the present rates on railroads excessive. Even 30s a ton, for the conveyance of our glass, is double what it ought to be.

Question No. 2844. Do you state that with reference to the charges on yourselves, or the excessive profit the railway company is making by the charges? Answer: I do not think they are making a profit by it. I think it is a mistake. I think they would receive a much greater amount by charging a much lower tonnage, than they do at present. I conceive that it will be found and that all experience will prove, that there would be an enormous increase of traffic, which does not at present exist, in consequence of a reduction of the rates. I have considered, that we get no goods from London, in consequence of the high rates. We use a large quantity of brimstone and large quantities of various other articles, of which, in consequence of the very high rates, along the canal and railroad, we never think of inquiring the prices in London; and yet, London is probably the best place perhaps, for purchasing such articles. Large quantities of those articles are imported into London, and we could often get them cheaper in London than in Liverpool. Some years ago, we made communication to the Grand Junction canal company that we could get *chalk* from Harefield, 16 miles from London, that cost us then 25s per on. By making arrangements with the Grand Junction canal company and other canals, we have got that article down to 12s per ton. The con-

sequence is, we use this article in our manufacture, and perhaps get 1500 tons a year from Harefied, which would never have come at all, but for that reduction. We should have otherwise used the limestone of our immediate neighborhood. The same with regard to sand. We used to get that from Lynn, which cost us 40s per ton. We afterwards got it from the Isle of Wight at 30s per ton. It was found to exist on the line of the Grand Junction canal and instead of charging us at the usual rate of 16s a ton, they charged us 2s 6d a ton. We thus got the cost reduced from 40s to 15s; and by that means, we are enable to carry on our manufacture, and but for those low charges, our manufactory would probably have no existence. Ours is the first house which has ever established a manufactory of window glass in that part of the kingdom. All the manufactories for articles of that description are on the coast. The effect of these reductions has been that the Grand Junction canal company have received considerable sums for the transmission of those articles at very low rates, whereas if they had kept up their rates, they would never have come on their canals.—

To the editor of the Daily Evening Transcript. Sir: Permit a stranger from the "far west" to express the peculiar satisfaction which the perusal of an article in your paper of yesterday—noticing the project of a railroad from Boston to St. Louis—afforded one who has for some years past taken a deep interest in the subject of a continuous line of steam communication from the extreme east to the remotest west of our magnificent continent. It encourages a hope that a *portion* at least, of the press of this city of "steady habits" is not indisposed to extend its co-operation towards advancing a western communication with points more remote than are circumscribed by the limits of your own State. In a short time, a continuous line of railroad will have been completed from Boston to the eastern shore of lake Michigan. This being done, a *direct* line of communication between Boston and the rich and flourishing Territories of Iowa and Wisconsin will have been completed—excepting only a distance of 150 miles, between lake Michigan and the Mississippi. Over this ground the general government has commenced the survey and location of a railroad; and its friends are anxious that the work should not be retarded for want of the influence which a favorable expression of regard on the part of those most interested, would be calculated to produce. The question then resolves itself into this: "Does Boston sufficiently appreciate the importance of a *direct* line of steam communication with fertile regions of the Upper Mississippi, to aid her distant brethren in asking Congress to prosecute without delay, that portion of the work (above referred to) lying within the limits of the Territory of Wisconsin. Fearing I have already trespassed too far upon your valuable space, I close for the present; hoping that you may deem my subject not unworthy some attention. I am sir, very Respectfully, Your obedient servant. IOWA.

Our citizens are wide awake to the importance, in a national point of view, as well as to themselves and to the millions of citizens on the long line—of a continuous railroad communication from Boston to the far west. They consider such an enterprise as worthy of the patronage of Congress. They accordingly, at the last session, caused a petition, signed by a mass of our active men, to be presented by J. Q. Adams, requesting the grant of public lands to aid in the enterprise, all along the long line. This petition like many others for purposes of national importance, was lost in the fog of Presidential electioneering. We trust, however, that it will be taken up at an early day, and be treated as the best measure for the national defence, the carrying of the mails, the advancing the price of public lands, and the advance of the morals and of the prosperiry of the country.

From the proceedings of the annual meeting of the western railroad corporation.

FARE ON RAILROADS.

The railroad system of Massachusetts is becoming daily of greater importance. But few years have elapsed since the first feeble efforts were made to establish the Worcester, road and many were the clouds which obscured its early prospects. Some predicted it could not resist a northern winter; that it would be buried in the drifting snow; that its cost would vastly exceed the estimate, and the travel would not support it. That if ever feasible, it was in advance of the age. At one period in its history, a meeting was called to arrest its progress; and there is no doubt, that many of its most zealous advocates would have sold their dividends for three per cent. per annum. But the road was carried through and crowned with success. The enterprise has been followed by others, and new avenues for trade are now diverging in every direction from Boston, overleaping the barries with which nature has shut out the trade of the interior, and daily widening the circle of our commerce. On the one side we have reached Taunton, Providence and Stonington, and are now pressing on towards New Bedford, Fall River and Nantucket; towns hitherto supplied by New York. On the other we have reached Worcester; are opening a new route through the manufacturing region of Connecticut, to Norwich and New London, and from Worcester are rapidly approaching the great and fertile valley of the Connecticut and the mighty west.

On the north, we are slowly progressing towards Concord, Burlington and Montreal. On the north-east, we are advancing towards Exeter, Dover, Somersworth, Berwick, Rochester, Centre Harbor and Haverhill, Coos and upper Vermont; and on the east, beyond Salem, and towards Newburyport, Portsmouth and Portland.

The railroads in this State, will, within a year from this date, have absorbed a capital of eleven millions of dollars, and their united length will be 300 miles. While we admire these Herculean undertakings, achieved in so brief a period by so small a State, with so great an outlay of capital and so little foreign assistance, and while we congratulate ourselves that they promise so good a return to the capitalist, and so great facilities to travellers, it is well to pause for a moment and consider whether they have answered all the expectations of the public, and are administered in a manner most conducive to the interest of the stockholders. To the citizens of Boston, this inquiry is particularly interesting, since its prosperity has become in a great measure identified with these railroads. Not only are her citizens the principal stockholders, but these roads all converge towards Boston, as a focal point, and there they are soon to connect with the line of steam packets, about to be established between Boston and Lievrpool. When these roads were first contemplated, and the charters asked of the legislature, the public were promised, not only a rapid passage, but also a great reduction in the charges for freight and passage. Has the latter promise been fulfiled:

It is with regret that we answer this question in the negative. Before railroads were established, the usual charge for stage travelling in this Commonwealth, varied from 4 to 5 cents per mile. For this compensation, the driver called for the traveller at his residence, received his trunk and left him at his hotel or dwelling at the end of the route. Several of our leading railroads have made little or no reduction from this charge; one of them, in particular, which has enjoyed a more liberal share of pub-

lic patronage than it bids fair to receive in future, seems merely to have aimed at destroying all competition and rivalry by its despatch, without any calculation of the benefits it would confer upon the public, or the remunerating patronage it would receive, from a proper reduction.

I do not hesitate to take the ground, that the present charges are too high, both for the interest of the stockholders and the public. It is a general principle, recognized by all intelligent statesmen, that the demand for luxuries increases more rapidly than the cost declines, when the reduction of price occurs. The aggregate value of the sugar, and tea and coffe, sold in England at a low price, greatly exceds the value of the same articles sold in the same market, when higher prices ruled.

Cheap amusements are the order of the day. At this moment, an association is forming in London, to build a concert room to accommodate 8,000 persons, at a shilling each, with a veiw to profit; and while our own concert rooms are nearly empty at a charge of a dollar, we see every week more than 10,000 people attending our music upon the common. Locomotion is the favorite recreation of Americans, and a healthful, innocent, and improving amusement. It is a recreation equally acceptable to the rich and the poor, and which all will enjoy in proportion to their ability. In a country where families increase so rapidly as in ours, and were the growth of new villages, and cities, and manufactories, call the sons and daughters from the paternal home, the claims of kindred induce travelling, and the oppressive heat of summer attracts crowds from the cities into the interior, whose visits are retuned during other seasons of the year.

To illustrate the fondness for locomotion, and the degree to which it prevails, where the price permits, it is merely necessary to advert to the fact, that on the 4th of July last, 7000 people passed over the Eastern Railroad, at an average charge of 43 cents each, and 2000 made an excursion to Nahant, with music, in a single steamer, at a charge of 25 cents each way. Or we might instance the lines of omnibuses to Roxbury, whose low rates haves increased the travel at least a thousand per cent. Travelling, then, with us, is both a luxury and necessary, and must be progressive as the price declines. It is observed,that, in this country, great equality of condition prevails, and the income of the farmer and the artisan falls but little short of the receipt of the the professions. All classes travel more or less; and as travelling is reduced so that it shall cease to be an expensive luxury, they will resort to this pleasing excitement in preference to all others. The expeiment of low fares has been successfully tried iu Belgium, by the government of that country, a rate has been adopted averaging 1 cent to 1¼ cents per mile, and the result is an increase of many hundred per cent. In Belgium, some clases of passengers are carried at the rate of eight mills per mile, and by the publication of the Chevalier de Gerstner, it appears, that these low rates furnish a fair income to the State, although the cost of the Belgium roads is double that of the agerage of American railroads, and the cost of sending a train over them is at least equal to the cost of a train moving over our own railroads. Instead of adopting the liberal and enlightened policy of Belgium, the directors of our roads seem to have in most instances, aimed at extracting as much as possible from each passenger;—to have supposed they have done all that was politic or advisable, if they have put down the competition of the stage and the baggage wagon; to have gone upon the assumption, that they have accomplished every thing, if they have received the existing travel, and the gain incident to increased speed, without taking at all into account, the vast travel they might call into existence by a reduced rate of fare, or the attendant benefits they might confer upon Boston and the State.